Report on Laboratory Experiment No 3
Hydrogen Spectrum Research and Determination of Rydberg Constant

The student:
Group ______________________________
First name________________________________
Last name________________________________
is **allowed** to do the laboratory work.

_______________ Date

_________________________ Signature of the teacher

Purpose of work

Study a visible region of the hydrogen emission spectrum and determination of Rydberg constant

Theoretical principals of work

Arrangement of the lines of the hydrogen emission spectrum is described by the formula:

____(1), where
λ is _________________________, R is ____________________________,
n is ____________________________________, m - ___________________________

From expression (1) follows that the hydrogen emission spectrum consist of several series which are represented in the scheme of energetic levels (Figure 1) by the vertical arrows.

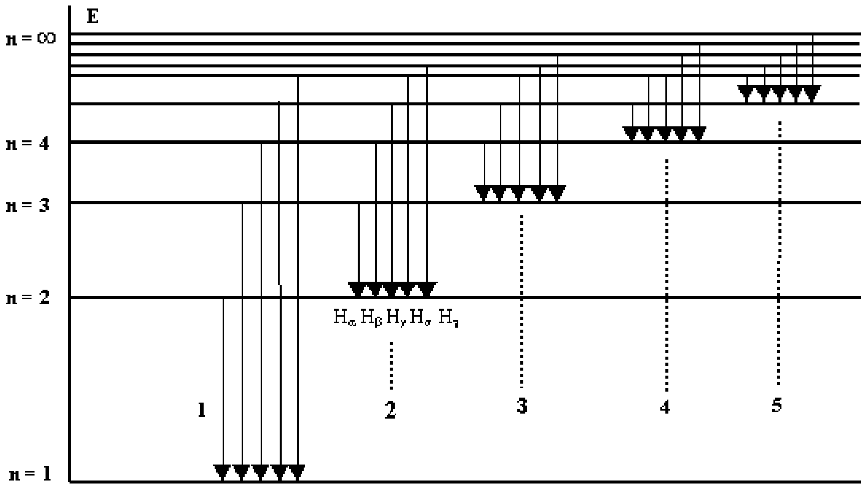


Fig.1.

It is clear from Figure 1 that Lyman series appears as a result of transition of atom from one of the higher levels with *m* = ______________ to the basic one *n* = _____________

The Balmer series – from the levels with *m* = _________ to the level with *n* =______
The Pashen series – from the levels with *m* = ________ to the level with *n* =______
The Brakket series – from the levels with *m* = _________ to the level with *n* =______
In this laboratory experiment the wavelength of the lines of the _______________series are measured. These lines are designated by the symbols:
H_α - red line (m = __), H_β - bluish-green (m = __), H_γ - blue (m = ___), H_δ - violet (m = __).

Experimental Setup

Figure 2 shows scheme of monochromator

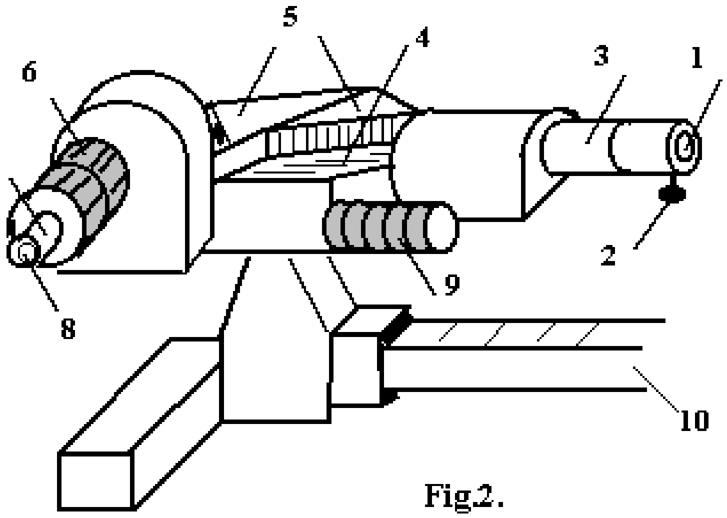


Fig.2.

Collimator is intended for ____
____
Prism is intended for ____
Output tube is intended for ____
____

MEASUREMENT RESULTS

a) Calibration of monochromator.
Calibrate monochromator means____
____
____
____

Record the results of calibration according the known mercury spectrum in the Table 1

Table 1

λ , nm							
n^0							

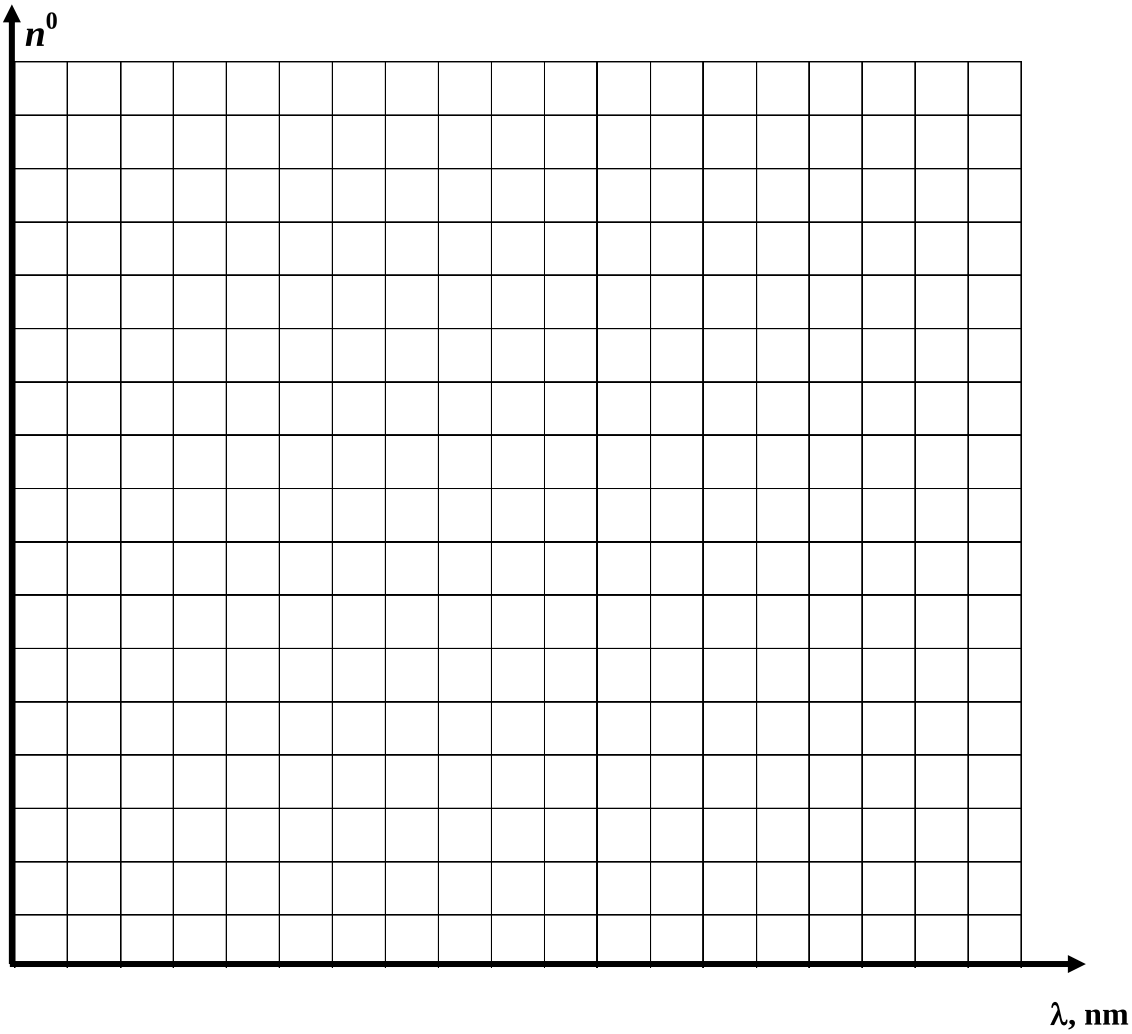
b) The Rydberg constant determination.
Replace mercury luminescent lamp by hydrogen discharge lamp and data of determination of spectral lines position of the Balmer series record to the table 2.

Table 2

m	3	4	5	6
n_0				
λ, nm				
$\bar{\nu}$, cm^{-1}				
R, cm^{-1}				

Results of Calculation

Calibration curve



By formula (1) calculate the Rydberg constant for m = ______________

$$R = \frac{\tilde{\nu}}{\frac{1}{n^2} - \frac{1}{m^2}} = \text{\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_}, \quad R_{av.} = \frac{\sum_1^4 R_i}{4} = \text{\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_}$$

Error Analysis

$\Delta\tilde{R} = \tilde{R}\frac{\Delta\tilde{\lambda}}{\tilde{\lambda}} -$ is estimation of absolute error for R; $\Delta\tilde{\lambda} =$ ____________________________

____________________ and finally $\Delta\tilde{R} =$ ____

Relative error $\frac{\Delta\tilde{R}}{R} \cdot 100\% =$ _____________________________________

Round off the value of $\Delta\tilde{R}$ and give the result in the form:

$$\overline{R} = \tilde{R} \pm \Delta\tilde{R} =$$

Resume

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Test questions

1. Cite Bohr's postulates.
2. What shape of the spectrum is characteristic for gaseous substances? What is the nature of spectral lines?
3. What peculiarities are in the hydrogen spectrum? Record a formula for the hydrogen spectral series. What senses have the values in this formula?
4. How many spectral series has the hydrogen spectrum? How does the Bohr theory explain an origin of these series?
5. Energy of hydrogen atom in the first exited state (n = 2) equals 3.4 eV. Calculate the energies of stationary states correspond to the H_α, H_β, H_γ, and H_δ lines.

Answers

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Realized by the student:
Group ________________________
First name____________________
Last name____________________
Approved by the teacher:

_________________ Date

________________________ Signature of the teacher